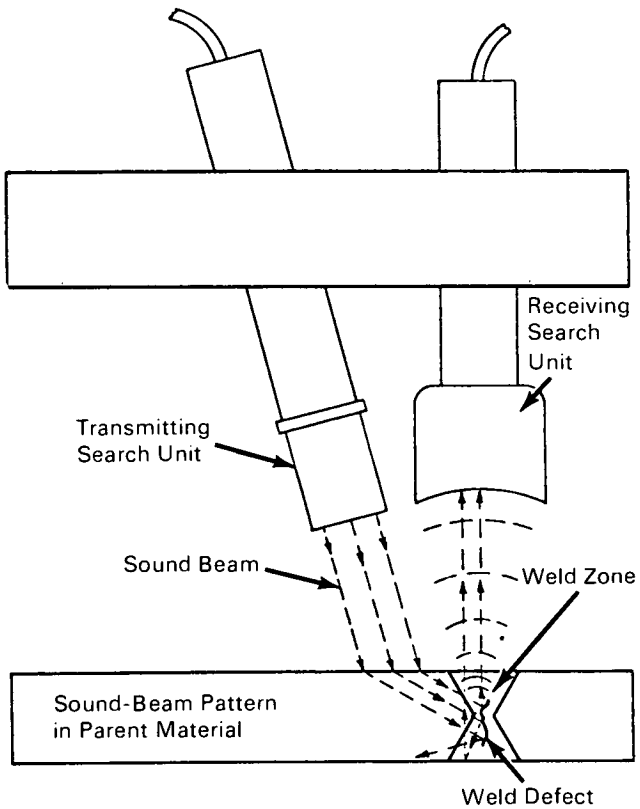
NASA TECH BRIEF

Ultrasonic Detection of Flaws in Fusion Butt Welds



Delta Configuration; Diagrammatic

The reliable and accurate Delta technique is a nondestructive ultrasonics method that uses redirection of energy for detection of flaws in fusion butt welds; randomly oriented imperfections can be detected. Data on flaws can be read from either an oscilloscope or a printout.

Ultrasonic sound energy is introduced into the material being investigated at an angle that produces shear-wave energy in the material (see fig.); for welds it is introduced into the adjacent parent material. The sound propagates in the material until it strikes an interface, which is anything differing in acoutic impedance from the parent material and interrupting the propagation pattern of the sound beam. The interface may be an inclusion, crack, or absence of weld penetration or fusion. At the interface the sound energy may be (1) simply reflected (it remains shear energy as long as it is within the material); (2) converted in mode from shear to longitudinal (this does not imply that the shear energy is absorbed; the shear and longitudinal energies occur simultaneously in the material and merely propagate in manners characteristic of their particular forms); or (3) reradiated (experiments have shown the apparent occurrence of this phenomenon, but the manner of its occurrence is unclear; in concept the defect acts as a new source of the sound energy).

Any energy redirected from the defect can provide information about the defect. The energy received at the receiving search unit (RSU) conveys information about the defect regardless of which of the several paths it followed to get there. The RSU is usually focused for increase in the angle of capture of the redirected energy. In thinner materials the lengths of the various paths are so short that they give the appearance of almost simultaneous occurrence; in thicker materials the various paths and modes can be separated and identified. The nature and operation of two Delta configurations are explained; a Delta Wheel and a Manual Delta Probe.

The defects of primary concern in weldments of aluminum alloys 2014 and 2219 have been detected at inspection rates of 50 ft/hr. An area lacking pene-

(continued overleaf)

tration and measuring 0.030 by 0.060 inch was reliably detected, as was an absence of fusion as narrow as 0.025 inch Microfissuring, a laminar shrinkage-type defect found in 3/16-inch and 1/4-inch weld sections, was detected while radiographic techniques failed because of unfavorable orientation of defects. Destructive analysis of 18 ft of weldment tested showed that ≤80% of total defects were detected by the Delta technique whereas only 36% were caught by radiography.

Note:

The following documentation may be obtained from:

Clearinghouse for Federal Scientific
and Technical Information
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.65)

Reference:

NASA-CR-61952 (N69-14207), Development of the Ultrasonic Delta Technique for Aluminum Welds and Materials

Patent status:

No patent action is contemplated by NASA.

Source: B. T. Cross, K. J. Hanna and W. M. Tooley of Automation Industries, Inc. under contract to Marshall Space Flight Center (MFS-20824,-20843)